POWER PLATE®

Physiological Responses During Maximal Incremental Cycling Test with and without Mechanical Vibration

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This is a summary of a preliminary study carried out at the Centre for Sports Science & Human Performance, University of Greenwich, UK

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Introduction:

Over the last two decades, research into whole body vibration (WBV) training has shown that it can improve several physical and physiological biomarkers such as strength, flexibility, balance, and bone mineral density (Cochrane, 2011; Sands et al., 2008). The Power Plate Rev™ represents a mechanical training ergometer specifically designed to apply vibration training (VT) to enhance human performance. A patented mechanism placed in the crank enables the bike to generate vibration that is transmitted to the pedals during cycling. The objective of this case study was to compare the body's physiological responses to a maximal incremental cycling test with and without vibration.

Method:

An active male endurance runner volunteered to participate in this pilot study (32yrs, 177cm, 72kg). The cycling protocol was approved by the University's Research Ethics Committee and the subject gave written consent. He performed two maximal incremental cycling test in random order (with or without vibration). He started with a four-minute warm-up at 70 rpm followed by an increasing cadence of 10rpm every 3 minutes until exhaustion. The mechanical vibration was cadence-related, being equivalent to a range between 23.3 and 40Hz.

Respiratory exchange gases [Oxygen uptake (VO2), Carbon Dioxide production (VCO2)], Respiratory Exchange Ratio (RER), Minute Ventilation (VE) and heart rates were continuously measured throughout the exercise protocol using a "Vacu Med, mini-CPX, USA" gas analyser and a heart rate monitor (Polar, Finland) respectively. A 25 µL blood sample was collected in the last 30 seconds of each stage from the finger tip and immediately analysed for the blood lactate (BL) concentration using Biosen 5030 lactate analyser. The subject's rate of perceived exertion (RPE) was recorded at the end of each stage during the test using the BORG scale (6 to 20).

Results:

Oxygen consumption (VO2) and carbon dioxide production (VCO2) during vibration and no vibration conditions are shown in Figure 1. A significant increase in the VO2 was observed during the vibration trial compared to the non-vibration condition. BL concentration was significantly higher from the start to the end of the vibration condition when compared to the non-vibration (Fig. 2). Similar patterns were noticed in the RPE and the cardiac response with the subject reaching 168 bpm in the non-vibration condition and 176 bpm in the vibration condition (see Fig. 3).

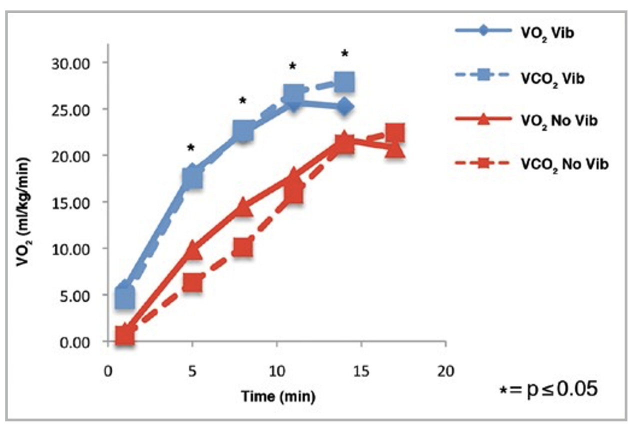

Fig 1: VO2 and VCO2 during maximal tests with and without vibration

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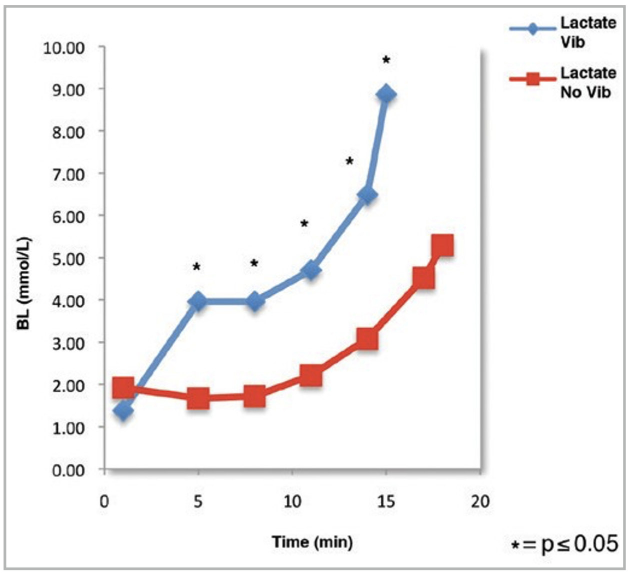

Fig 2: Lactate production during maximal tests with and without vibration

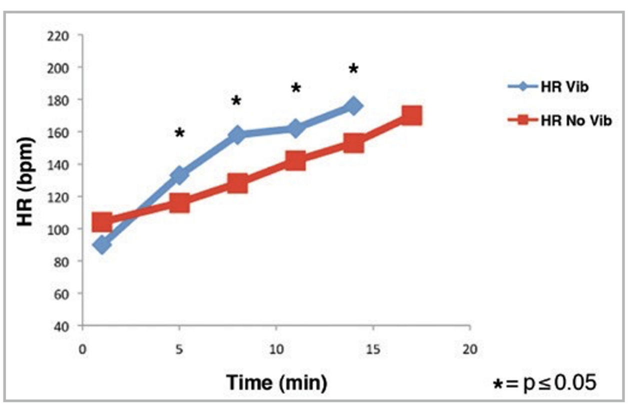

Fig 3: HR during maximal tests with and without vibration

Conclusion:

The outcomes of this case study show that the addition of mechanical vibration during cycling imposes a significant increase in the physiological and metabolic biomarkers of the aerobic performance. This suggests an increased muscle activation that results in an increased energetic cost of the cycling exercise performed at similar cadence.

The mechanism providing the mechanical vibration is responsible for the increase in power output in the same way as increasing the resistance. Testing showed that, when cycling at the same cadence, level 1 with vibration was the same as cycling at level 5 without vibration.